

# **EXHIBIT D**



US007522424B2

(12) **United States Patent**  
**Mambakkan et al.**

(10) **Patent No.:** **US 7,522,424 B2**

(45) **Date of Patent:** **\*Apr. 21, 2009**

(54) **SMARTCONNECT UNIVERSAL FLASH  
MEDIA CARD ADAPTERS**

(75) Inventors: **Sreenath Mambakkan**, San Jose, CA  
(US); **Venkidu Arockiyaswamy**, Menlo  
Park, CA (US); **Larry Lawson Jones**,  
Palo Alto, CA (US)

(73) Assignee: **MCM Portfolio LLC**, Cupertino, CA  
(US)

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 173 days.

This patent is subject to a terminal dis-  
claimer.

(21) Appl. No.: **11/858,086**

(22) Filed: **Sep. 19, 2007**

(65) **Prior Publication Data**

US 2008/0009196 A1 Jan. 10, 2008

**Related U.S. Application Data**

(63) Continuation of application No. 11/492,556, filed on  
Jul. 24, 2006, now Pat. No. 7,295,443, which is a  
continuation of application No. 10/887,635, filed on  
Jul. 8, 2004, now Pat. No. 7,095,618, which is a con-  
tinuation-in-part of application No. 10/064,966, filed  
on Sep. 4, 2002, now Pat. No. 6,859,369, which is a  
continuation-in-part of application No. 10/167,925,  
filed on Jun. 11, 2002, now Pat. No. 7,222,205, and a  
continuation-in-part of application No. 10/002,567,  
filed on Nov. 1, 2001, now abandoned, and a continu-  
ation-in-part of application No. 10/039,685, filed on  
Oct. 29, 2001, now Pat. No. 6,832,281, which is a  
continuation of application No. 09/610,904, filed on  
Jul. 6, 2000, now Pat. No. 6,438,638.

(51) **Int. Cl.**  
**H05K 7/02**

(2006.01)

(52) **U.S. Cl.** ..... **361/737**; 439/945; 439/946;  
439/638; 235/492

(58) **Field of Classification Search** ..... 361/737,  
361/730, 736, 752; 439/945, 946, 638, 76.1;  
235/492

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,296,692 A 3/1994 Shino  
(Continued)

**FOREIGN PATENT DOCUMENTS**

DE 20109810 U 8/2001  
(Continued)

**OTHER PUBLICATIONS**

Supplementary Search Report for EP Application No. 01952974.2, 3  
pages, Sep. 21, 2004.

(Continued)

*Primary Examiner*—Ishwar I. B. Patel

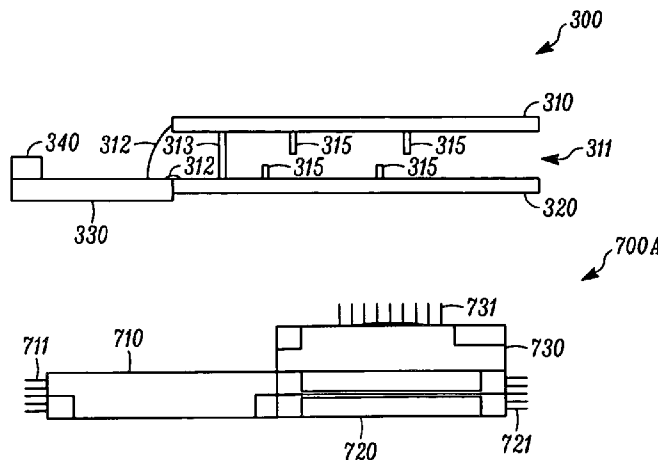
*Assistant Examiner*—Dameon E Levi

(74) *Attorney, Agent, or Firm*—John P. Ward; Greenberg  
Traurig LLP

(57) **ABSTRACT**

A multi-memory media adapter comprised of a first planar  
element having an upper surface and a lower surface, a second  
planar element having an upper surface and a lower surface,  
and formed from a single material. The two planar elements  
form at least one port, each port capable of receiving one or  
more types of a memory media card. The adapter has at least  
one set of contact pins protruding from the lower surface of  
the first planar element or the upper surface of the second  
planar element such that the at least one set of contact pins are  
disposed within the port. The at least one set of contact pins  
are capable of contacting the contacts of a memory media  
card inserted into the port. For one embodiment a controller  
chip is embedded within the single material forming the  
multi-memory media adapter.

**30 Claims, 5 Drawing Sheets**



## US 7,522,424 B2

Page 2

## U.S. PATENT DOCUMENTS

5,394,206	A	2/1995	Cocca	6,599,147	B1	7/2003	Mills et al.	
5,471,038	A	11/1995	Eisele et al.	6,658,516	B2	12/2003	Yao	
5,576,698	A	11/1996	Card et al.	6,663,007	B1	12/2003	Sun et al.	
5,584,043	A	12/1996	Burkart	6,684,283	B1	1/2004	Harris et al.	
5,589,719	A	12/1996	Fiset	6,718,274	B2	4/2004	Huang et al.	
5,640,541	A	6/1997	Bartram et al.	6,738,259	B2 *	5/2004	Le et al.	361/737
5,679,007	A	10/1997	Potdevin et al.	6,746,280	B1	6/2004	Lu et al.	
5,729,204	A	3/1998	Fackler et al.	6,751,694	B2	6/2004	Liu et al.	
5,752,857	A	5/1998	Knights	6,761,313	B2	7/2004	Hsieh et al.	
5,786,769	A	7/1998	Coteus et al.	6,761,320	B1	7/2004	Chen	
5,802,553	A	9/1998	Robinson et al.	6,832,281	B2	12/2004	Jones et al.	
5,815,426	A	9/1998	Jigour et al.	6,839,864	B2	1/2005	Mambakkam et al.	
5,828,905	A	10/1998	Rao	6,859,369	B2 *	2/2005	Mambakkam et al.	361/737
5,844,910	A	12/1998	Nijima et al.	7,062,584	B1	6/2006	Worrell et al.	
5,877,975	A	3/1999	Jigour et al.	7,095,618	B1 *	8/2006	Mambakkam et al.	361/737
5,887,145	A	3/1999	Harari et al.	7,295,443	B2 *	11/2007	Mambakkam et al.	361/737
5,892,213	A	4/1999	Ito	2002/0032813	A1	3/2002	Hosaka et al.	
5,905,888	A	5/1999	Jones et al.	2002/0178307	A1	11/2002	Pua et al.	
5,928,347	A	7/1999	Jones	2002/0185533	A1	12/2002	Shieh et al.	
5,930,496	A	7/1999	MacLaren et al.	2003/0038177	A1	2/2003	Morrow	
D416,541	S	11/1999	Hirai et al.	2003/0084220	A1	5/2003	Jones et al.	
5,995,376	A	11/1999	Schultz et al.	2003/0093606	A1	5/2003	Mambakkam et al.	
6,002,605	A	12/1999	Iwasaki et al.	2004/0027879	A1	2/2004	Chang	
6,006,295	A	12/1999	Jones et al.	2004/0073736	A1	4/2004	Oh et al.	
6,009,492	A	12/1999	Matsuoka					
6,015,093	A	1/2000	Barrett et al.					
6,026,007	A	2/2000	Jigour et al.					
6,067,234	A	5/2000	Kim et al.					
6,075,706	A	6/2000	Learmonth et al.					
6,088,802	A	7/2000	Bialick et al.					
6,097,605	A	8/2000	Klatt et al.					
6,102,715	A	8/2000	Centofante					
6,132,223	A	10/2000	Seeley et al.					
6,145,046	A	11/2000	Jones et al.					
6,170,029	B1	1/2001	Kelley et al.					
6,175,517	B1	1/2001	Jigour et al.					
6,182,162	B1	1/2001	Estakhri et al.					
6,189,055	B1	2/2001	Eisele et al.					
6,199,122	B1	3/2001	Kobayashi					
6,202,932	B1	3/2001	Rapeli					
6,203,378	B1	3/2001	Shobara et al.					
6,264,506	B1	7/2001	Yasufuku et al.					
6,266,724	B1	7/2001	Harari et al.					
6,279,069	B1	8/2001	Robinson et al.					
6,292,863	B1	9/2001	Terasaki et al.					
6,330,688	B1	12/2001	Brown					
6,353,870	B1	3/2002	Mills et al.					
6,402,558	B1 *	6/2002	Hung-Ju et al.					439/638
6,405,323	B1	6/2002	Lin et al.					
6,408,352	B1	6/2002	Hosaka et al.					
6,413,108	B2	7/2002	Centofante					
6,470,284	B1	10/2002	Oh et al.					
6,490,163	B1	12/2002	Pua et al.					
6,578,125	B2	6/2003	Toba					
6,581,830	B1	6/2003	Jelinek et al.					

## FOREIGN PATENT DOCUMENTS

EP	0775964	A2	9/1996
EP	0987876	A2	8/1997
EP	1043884	A1	10/2000
EP	1139208	A1	10/2001
JP	6195524		7/1994
JP	08235028	A	9/1996
JP	11053485	A	2/1999
TW	490889	B	6/2002

## OTHER PUBLICATIONS

Antec, Inc., "PhotoChute3 USB," product manual, pp. 1-18, available at least by Apr. 26, 1999.

Burge, Leland L., et al., "A Ubiquitous Stable Storage for Mobile Computing Devices," ACM, Proceedings of the 2001 ACM Symposium on Applied Computing, pp. 401-404, Mar. 2001.

CompactFlash Association, "CF+ and Compact Flash Specification," Rev. 1.4, 5 pages, Jul. 1999.

CQ Publishing of Japan, "Interface," pp. 52-131, Dec. 1, 1999 (article and English translation).

Twice.com, "Digital Imaging Well Exposed at RetailVision," 1 page, Apr. 26, 1999.

Lexar Media Web Pages—Parallel Port, Universal Readers, FAQ, Jumpshot, Jun. 5, 2000 (copy not available; previously submitted in parent U.S. Appl. No. 09/610,904).

Microtouch Smart Media to PCMCIA Adapter Product Sheet, Jun. 8, 2000 (copy not available; previously submitted in parent U.S. Appl. No. 09/610,904).

Lexmark Service Manual, 5000 and 5700 Color Jetprinter; 5770 Photo Jetprinter, 4093/4094, Oct. 2000, p. 5-3.

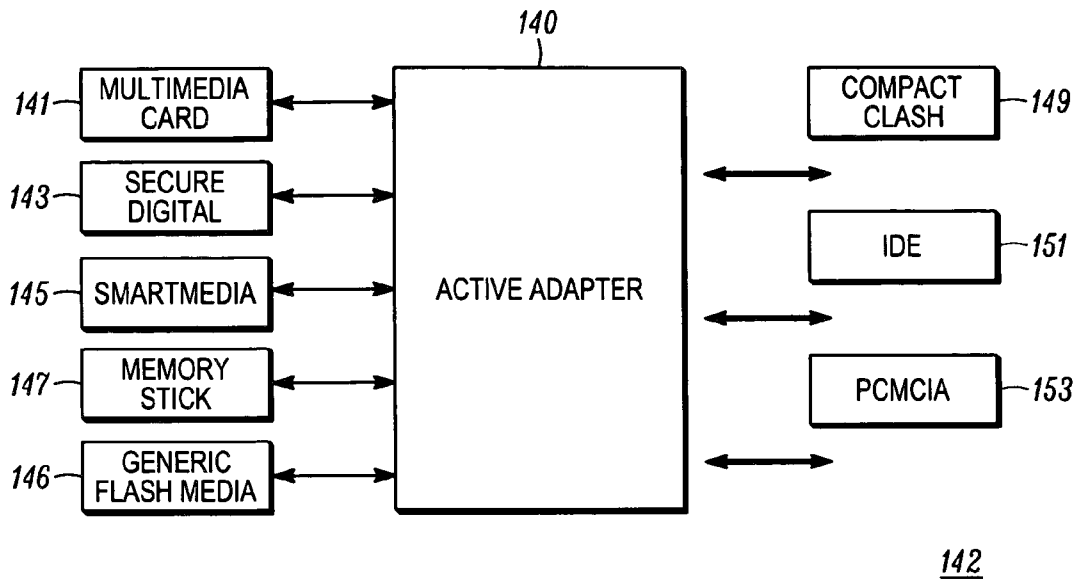
\* cited by examiner

U.S. Patent

Apr. 21, 2009

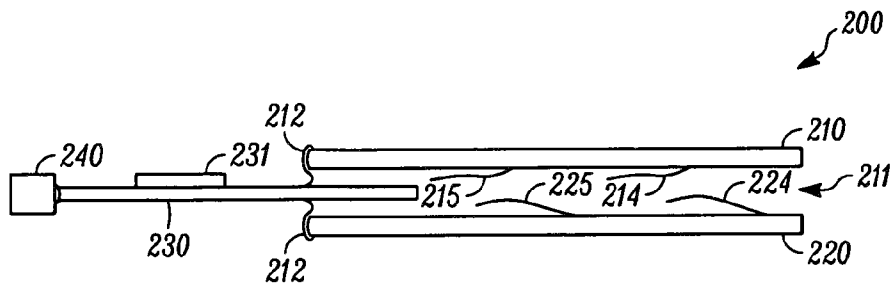
Sheet 1 of 5

US 7,522,424 B2



(PRIOR ART)

FIG. 1



(PRIOR ART)

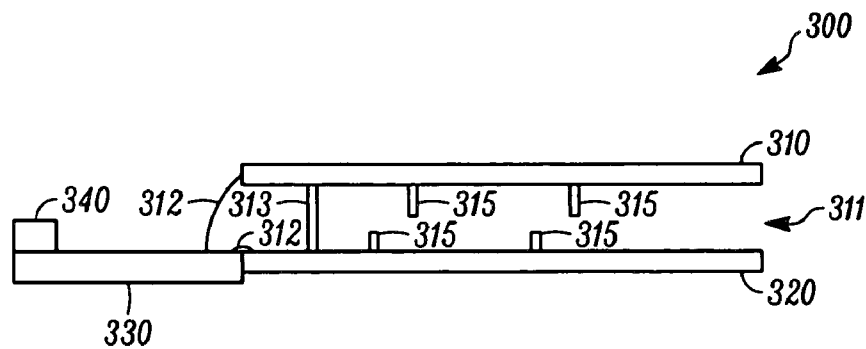
FIG. 2

U.S. Patent

Apr. 21, 2009

Sheet 2 of 5

US 7,522,424 B2

*FIG. 3*

## CONNECTOR PINS

PIN	SMART MEDIA	MMC/ SD	MEMORY STICK
1	D0/-WPSW		
2	D1	-WP	
3	D2	-CD	
4	D3	MCMD	
5	D4		-CD
6	D5		BS
7	D6		SDIO
8	D7		
9	LVD		
10	-WE	D0	
11	-RE	D1	
12	-ALE	D2	
13	-CLE	D3	
14	READY		
15	-CE		
16	-WP		
17	-WPSW		
18	GROUND	GROUND	GROUND
19	POWER		
20		POWER	POWER
21		CLK	MCLK

*FIG. 4*

PIN	XD	MMC/SD (REGULAR SIZE)	MEMORY STICK (REGULAR SIZE)	SMART MEDIA	MINISD	RS MMC	MEMORY STICK DUO
1	GROUND	GROUND	GROUND	GROUND	GROUND	GROUND	GROUND
2	-CD1						
3	RDY	MCMD	BS	RDY	MCMD	MCMD	BS
4	-RE	SD0	SDIO (MSD0)	-RE	SDD0	SDD0	SDIO (MSD0)
5	-CS	SD1	MSD1	-CS	SDD1	SDD1	MSD1
6	CLE	SD2	MSD2	CLE	SDD2	SDD2	MSD2
7	ALE	SD3	MSD3	ALE	SDD3	SDD3	MSD3
8	-WE	CLK	CLK	-WE	CLK	CLK	CLK
9	WP	-WP		WP			
10	D0	-CD2		D0			
11	D1		-CD3	D1			
12	D2			D2/-CD4			
13	D3			D3	-CD5		
14	D4			D4		-CD6	
15	D5			D5			-CD7
16	D6			D6/-WPSW			
17	D7			D7/LVD			
18	POWER	POWER	POWER	POWER	POWER	POWER	POWER

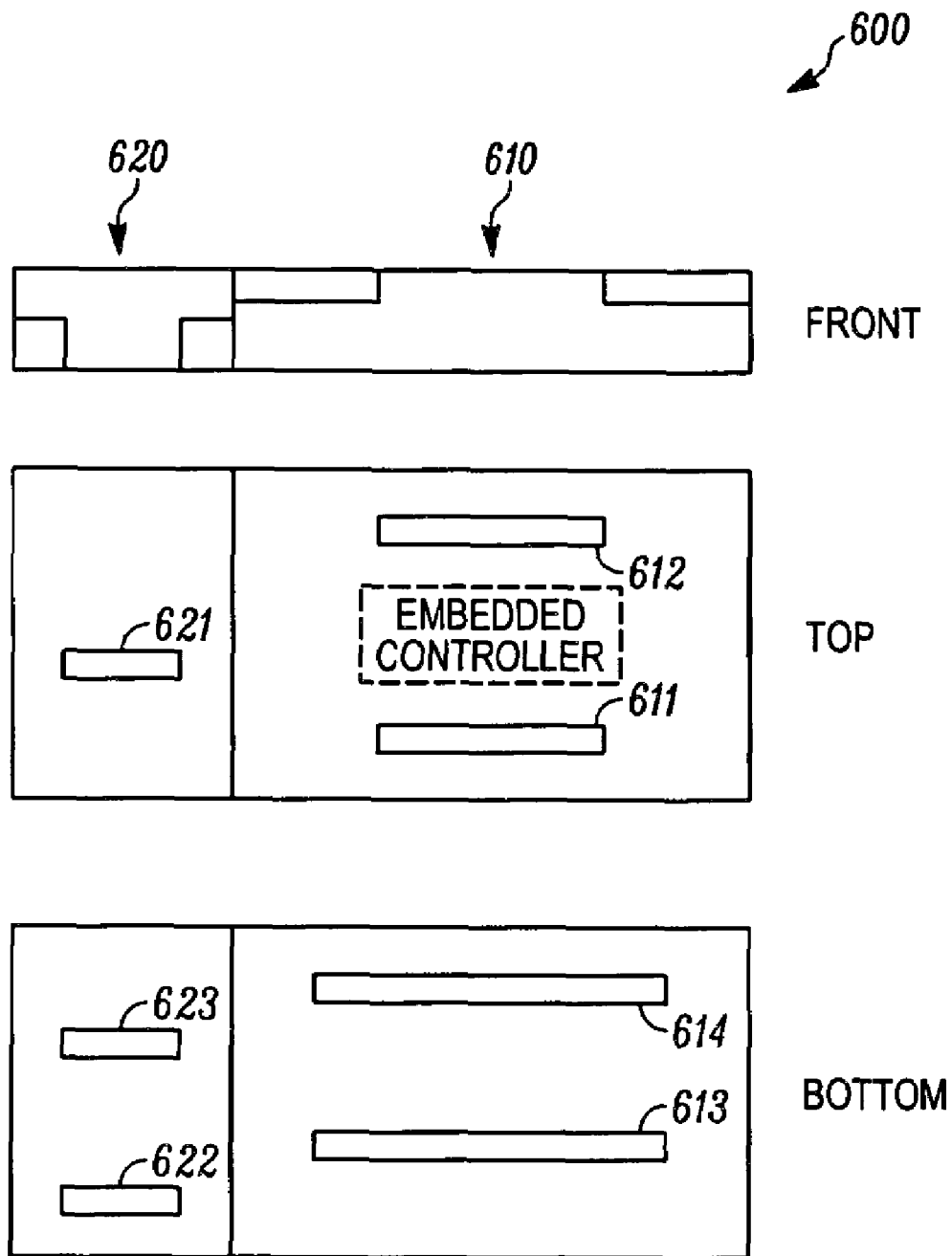
FIG. 5

U.S. Patent

Apr. 21, 2009

Sheet 4 of 5

US 7,522,424 B2



*FIG. 6*

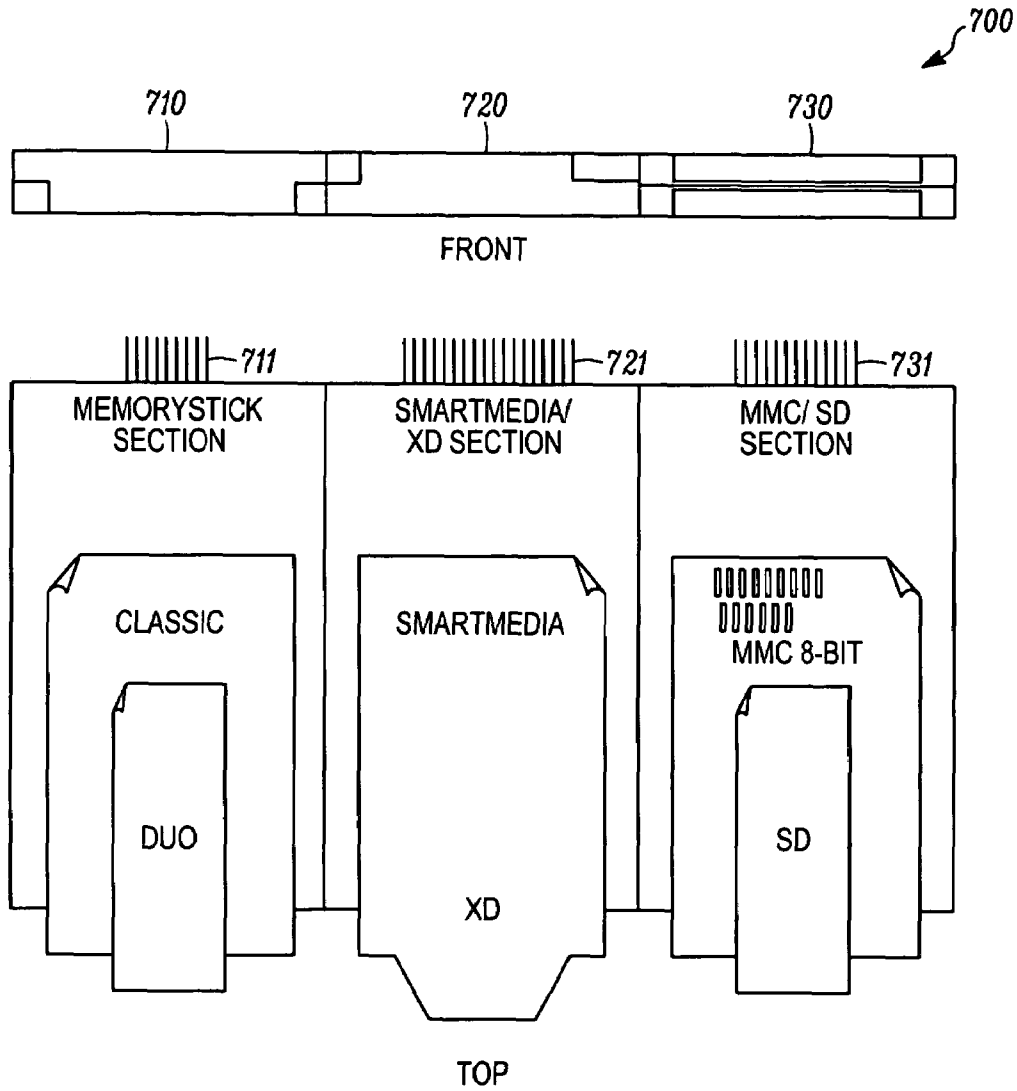


FIG. 7

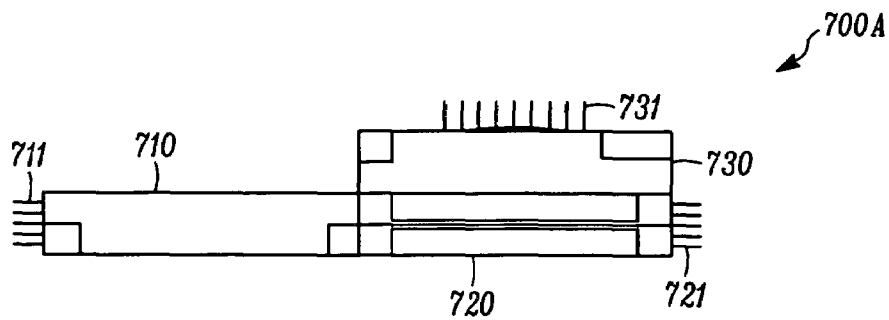


FIG. 7A



US 7,522,424 B2

1

# SMARTCONNECT UNIVERSAL FLASH MEDIA CARD ADAPTERS

## CROSS-REFERENCES TO RELATED APPLICATIONS

Under 35 U.S.C. §120, this application is a continuation application of U.S. application Ser. No. 11/492,556 filed Jul. 24, 2006 now U.S. Pat. No. 7,295,443 which is a continuation of U.S. application Ser. No. 10/887,635 filed Jul. 8, 2004, now U.S. Pat. No. 7,095,618, which is a continuation-in-part application of U.S. application Ser. No. 10/064,966, which was filed on Sep. 4, 2002, now U.S. Pat. No. 6,859,369, which is a continuation-in-part application of U.S. application Ser. No. 10/167,925, which was filed on Jun. 11, 2002, now U.S. Pat. No. 7,222,205, which is a continuation application of U.S. application Ser. No. 09/610,904 which was filed Jul. 6, 2000, now U.S. Pat. No. 6,438,638, and is titled "Flashtoaster for reading several types of flash memory cards with or without a PC." U.S. application Ser. No. 10/064,966 is also a continuation-in-part of U.S. application Ser. No. 10/039,685 which was filed Oct. 29, 2001, now U.S. Pat. No. 6,832,281 and is titled, "Flashtoaster for reading several types of flash memory cards with or without a PC" and a continuation-in-part of U.S. application Ser. No. 10/002,567 which was filed Nov. 1, 2001 now abandoned and is titled, "Active Adapter Chip for Use in a Flash Card Reader." The priority of the above-referenced applications is hereby claimed, and the entirety of the above-referenced applications are incorporated herein by this reference, and all of the above-referenced applications are assigned to the assignee of the present invention.

## COPYRIGHT NOTICE/PERMISSION

A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyright rights whatsoever.

## FIELD

The present invention relates generally to flash media adapters, and more specifically to an improved configuration of the same.

## BACKGROUND OF THE INVENTION

In U.S. patent application Ser. No. 10/002,567, entitled "Active Adapter Chip for Use in a Flash Card Reader", filed Nov. 1, 2001, and assigned to the assignee of the present application, a universal active adapter chip is disclosed that can be used to construct a flash media system or various active flash media adapters using the CompactFlash card or PCMCIA (PC Card) form factor. A standard reader that reads CompactFlash cards or PC cards can then read any of the other flash-memory cards that plug into the CompactFlash or PC Card adapter. The adapters come with a conversion chip that makes each of the flash media work just like a CompactFlash or PC Card media, as applicable.

FIG. 1 shows a multi-standard card reader system **142**. In the field of multi-standard adapters, multi-memory media adapter **140** may be an active adapter or, alternatively, may be a passive adapter. Reader **142** can adapt on the host side to

2

either CompactFlash card **149**, PCMCIA card **153**, or IDE card **151**. On the media side, the reader can adapt to a Multi-MediaCard **141**, or a Secure Digital card **143**, which have the same form factor but slightly different pin-out; a SmartMedia card **145**, which has a different pin-out; or a Memory Stick **147**. In general, the reader **142** can adapt to any generic flash media **146** that has a similar or smaller form factor.

It is possible to place the connector such that all the media sit in one opening. FIG. 2 is a cutaway side view of a PCMCIA adapter card **200** of the type that is available as a standard commercial product today. FIG. 2 illustrates several drawbacks in the typical configuration of a PCMCIA adapter. Adapter **200** includes two PCBs, namely PCB **210** and PCB **220**. The two PCBs are separated by a mounting frame (typically plastic), not shown. The mounting frame acts as a spacer between PCB **210** and PCB **220**, which holds the two PCBs together at a specified distance and functions in other capacities as described below. The space between the two PCBs creates the opening (port) **211** into which the flash media cards are inserted. PCB **230** is straddle-mounted between PCB **210** and PCB **220**. PCB **230** contains the active components including controller chip **231** that perform handshaking and data transfer. PCB **230** is connected to a PCMCIA connector **240**. PCB **230** is mounted between PCB **210** and PCB **220** with interconnects **212**. PCB **210** has two sets of floating contact pins, contact pin set **214** includes nine contact pins and contact pin set **215** includes ten contact pins, which provide interfaces for MMC/SD and MemoryStick flash media respectively. PCB **220** has two sets of floating contact pins **224** and **225**, each including 11 pins, which together provide the interface for SmartMedia flash media.

The mounting frame that holds PCB **210** and **220** together is configured such that each type of flash media is inserted in a particular location within the connector. In FIG. 2, opening **211** is a simplified view. Typically, the opening is stepped with different widths and heights in different locations that index the flash media cards into specific locations upon insertion. This allows each flash medium to be properly aligned with the corresponding contact pin set(s). Additionally, stops are typically provided to stop the insertion at the correct depth, again, to guarantee connection to the right contact pin set.

This typical approach has several serious drawbacks.

## Manufacturing

The straddle-mount configured flash media adapter is very expensive to manufacture for several reasons. Often such devices require manual labor for manufacturing and testing, or the use of very expensive soldering robots, instead of standard production techniques. A further problem is the additive effect of manufacturing tolerances, such as primary connector (i.e., PCMCIA) to PCB, to straddle mount connector to secondary PCB to contacts on PCB, resulting in as many as two, three, or in some cases even four tolerances adding up, which makes requirements for tolerances either absurdly expensive, or causes a big yield problem in manufacturing. Additionally, PCB **230** must be thin enough so that it can be mounted between PCB **210** and PCB **220** in the space allocated for the insertion of the various flash media. That is, PCB **230**, together with the interconnects **212** that mount it between PCB **210** and PCB **220** must be no larger than opening **211**. The manufacture of thin PCBs to accommodate this design point adds to the expense and complexity of manufacturing the flash media adapter.

## Contact Pins

The floating contact pins are subject to damage and deterioration. The various flash media cards have different thick-

US 7,522,424 B2

3

ness, and even the same flash media may have different thickness if produced by different manufacturers. The flash media cards exert pressure upon the floating contact pins, which eventually causes their resiliency to be reduced. When subsequently, a thinner flash media card is inserted into the flash media adapter, the corresponding contact pins may not make connection with the flash media card. Additionally if a flash media card is inserted incorrectly (e.g., upside down), removal of the flash media card may damage the contact pins.

#### Interface

Some devices don't have the 68-pin PCMCIA interface. For example, some recent notebook computer models only have the electrically equivalent 50-pin CF interface. Typical adapter cards such as PCMCIA adapter card **200** are incompatible with a 50-pin CF interface.

#### SUMMARY

An embodiment of the present invention provides a multi-memory media adaptor comprised of a first planar element having an upper surface and a lower surface and a second planar element having an upper surface and a lower surface. The two planar elements are formed from a single piece of molded plastic and disposed so as to form a port capable of receiving a memory media card. The adapter has at least one set of contact pins protruding from the lower surface of the first planar element or the upper surface of the second planar element such that the at least one set of contact pins are disposed within the port. The at least one set of contact pins are capable of contacting the contacts of a memory media card inserted into the port.

Other features and advantages of embodiments of the present invention will be apparent from the accompanying drawings, and from the detailed description, that follows below.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be best understood by referring to the following description and accompanying drawings that are used to illustrate embodiments of the invention. In the drawings:

FIG. 1 illustrates a multi-standard card reader system;

FIG. 2 is a cutaway side view of a PCMCIA adapter card of the type that is available as a standard commercial product today;

FIG. 3 is a cutaway side view of an integrated standard connector adapter card according to one embodiment of the present invention;

FIG. 4 is a table of pin mappings for the SmartMedia, MMC/SD, and Memory Stick to a 21-pin connector in accordance with one embodiment of the present invention;

FIG. 5 is a table of pin mappings for the xD, standard MMC/SD, standard Memory Stick, SmartMedia, miniSD, RSMHC, and MS Duo to an 18-pin connector in accordance with one embodiment of the present invention;

FIG. 6 illustrates an integrated standard connector adapter card, according to one embodiment of the present invention, in front view, top view, and bottom view;

FIG. 7 illustrates an integrated standard connector adapter card, according to one embodiment of the present invention, in front view and top view; and

FIG. 7A illustrates an alternative embodiment of an adapter **700A** in accordance with one embodiment of the invention.

4

#### DETAILED DESCRIPTION

An embodiment of the present invention provides a multi-memory media adapter card configured to reduce or eliminate some of the drawbacks of typical adapter card configuration. In accordance with various embodiments of the present invention, the top and bottom PCBs of prior art configurations are replaced by molded plastic elements that provide greater structural integrity. The straddle-mounted controller board is replaced with a PCB adjacent to the bottom element and having a surface mounted standard connector that may be a PCMCIA or a CompactFlash connector. The contact pins are formed so as to better maintain their resiliency and avoid damage upon removal of the memory media card. In one embodiment, a light pipe is locked in place between the top and bottom elements of the adapter card so as to conduct light from a signal lamp on the PCB through the port.

It is an intended advantage of one embodiment of the present invention to reduce the manufacturing cost and complexity of an adapter card. It is another intended advantage of one embodiment of the present invention to provide an adapter card with greater structural integrity. It is another intended advantage of one embodiment of the present invention to provide an adapter card with contact pins that retain their resiliency to a greater degree than floating contact pins. It is another intended advantage of one embodiment of the present invention to provide an adapter card with contact pins that are less likely to be damaged upon removal of a memory media card. It is another intended advantage of one embodiment of the present invention to provide an adapter card with a surface mounted standard connector including PCMCIA and CompactFlash connectors.

In the following description, numerous specific details are set forth. However, it is understood that embodiments of the invention may be practiced without these specific details. In other instances, well-known circuits, structures and techniques have not been shown in detail in order not to obscure the understanding of this description.

Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

Similarly, it should be appreciated that in the foregoing description of exemplary embodiments of the invention, various features of the invention are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed embodiment. Thus, the claims following the Detailed Description are hereby expressly incorporated into this Detailed Description, with each claim standing on its own as a separate embodiment of this invention.

FIG. 3 is a cutaway side view of an integrated standard connector adapter card according to one embodiment of the present invention. Adapter card **300**, shown in FIG. 3, includes a top planar element **310** and a bottom planar ele-

## US 7,522,424 B2

5

ment **320**, both of which may be PCBs. Alternatively, the top planar element **310** and the bottom planar element **320** may be formed from molded plastic. A spacer, not shown, holds the two planar elements apart, forming port **311** into which memory media cards are inserted. In order to meet the low height requirements (thickness of PCMCIA or CF cards), the ports are registered on one opening, and contacts are distributed on both sides. Additionally, the port **311** may be formed with card stops to prevent improper insertion of memory media cards.

For one embodiment, both planar elements and the spacer between them are created from molded plastic. For such an embodiment, the molded plastic provides greater resistance to pressure applied to the outer surfaces of adapter card **300**. This helps to prevent planar element **310** and planar element **320** from contacting each other and possibly damaging internal components.

Adapter **300** also includes a number of sets of contact pins, shown collectively as contact pin set **315**, protruding from the lower surface of planar element **310** and from the upper surface of planar element **320**. The contact pins electrically couple to corresponding contacts on a memory media card inserted into port **311**. For an embodiment in which the planar elements **310** and **320** are formed from molded plastic, contact pin sets **315** may be formed from injected contacts with protruding pins. This provides a more robust contact pin than the floating contact pins of the prior art, thereby lessening the likelihood that the resiliency of the contact pin will be reduced to the point that the pin no longer contacts the inserted memory media card. Alternatively, or additionally, the contact pins may be angled or shaped such that damage due to the abrupt removal of an improperly (or properly) inserted card is reduced or eliminated. For example the terminal end of the contact pin may be angled or curved toward the planar surface from which the contact pin protrudes, or may be spherically shaped.

Adapter **300** includes planar element **330** that has standard connector **340** mounted thereon. Planar element **330** is adjacent to bottom planar element **320**. Standard connector **340**, which may be for example, a compact flash, PCMCIA, USB, or serial ATA connector is surface-mounted to planar element **330**. Interconnects **312** that electrically connect the standard connector **340** to contact pins **315** are also located on planar element **330**. The adapter connects the proper pin from the contact pins to planar element **330**. Simple wiring such as individual wires, flat cables, printed-circuit board (PCB), or wiring traces can be used. In accordance with an embodiment of the present invention, the need for a straddle-mounted PCB, and its associated manufacturing costs and complexity, is eliminated. Moreover, by eliminating the layers of a straddle-mount configuration, registration accuracy is improved. For one embodiment, a single PCB may comprise bottom planar element **320** and planar element **330**.

For one embodiment, a multi-memory media adapter having only **21** pins is used to accommodate various commercially available flash memory media. FIG. **4** is a table of pin mappings for the SmartMedia, MMC/SD, and Memory Stick to a 21-pin connector in accordance with one embodiment of the present invention.

Pin **18** is a ground pin for each connector. Pin **19** is a power pin for SmartMedia, while pin **20** is a power pin for MMC/SD, and Memory Stick.

The SmartMedia interface has a parallel data bus of 8 bits. These are mapped to pins **1-8**. While no separate address bus is provided, address and data are multiplexed. Control signals for latch enables, write enable and protect, output enable, and ready handshake are among the control signals.

6

For the Memory Stick and MMC/SD flash-memory-card interfaces, parallel data or address busses are not present. Instead, serial data transfers occur through serial data pin DIO, which is mapped to pin **7** for the Memory Stick, and pin **10** (DO) for the MMC/SD flash-memory-card interfaces. Data is clocked in synchronization to clock MCLK and CLK, for Memory Stick and MMC/SD, respectively, on pin **2L**. A BS, for Memory Stick, occupies pin **6**, and a command signal CMD, for MMC/SD, occupies pin **4**. The Memory Stick interfaces require only 4 pins plus power and ground, while MMC/SD requires 8 pins plus power and ground.

Thus, it is possible to accommodate SmartMedia, MMC/SD, and Memory Stick with a 21-pin connector (i.e., instead of 41 pins) by multiplexing the available pins. For one embodiment, the controller chip (e.g., controller chip **231**) differentiates the pin configuration for each flash memory media type. The controller may include a shifter connected to the data and clock signals from the MMC/SD and Memory Stick flash-memory cards. The shifter may clock one bit (serial) or word (parallel) of data each clock pulse. A cyclical redundancy check (CRC) can be performed on the data to detect errors.

For an alternative embodiment, a multi-memory media adapter, having only 18 pins, is used to accommodate various commercially available flash memory media including media that have recently become commercially available. Such recent additions include a miniSD card (i.e., an MMC/SD card with a smaller form factor), an MS Duo (i.e., a Memory Stick card with a smaller form factor), a Reduced Size MultiMedia Card (RSMMC), and an xD card (a controller-less Flash media, similar in function to SmartMedia).

FIG. **5** is a table of pin mappings for the xD, standard MMC/SD, standard Memory Stick, SmartMedia, miniSD, RSMMC, and MS Duo to an 18-pin connector in accordance with one embodiment of the present invention.

For such an embodiment, pin **1** is a ground pin and pin **18** is a power pin for each connector. The data lines for the SmartMedia and xD interface cards have a parallel data bus of 8 bits denoted as D0-D7 that occupy pins **10-17**. These data bus lines are multiplexed to serve as card-detect lines for the remaining media types. As described in application Ser. No. 09/610,904 (now U.S. Pat. No. 6,438,638), the signal lines to the controller are normally pulled high. When a card is inserted, the card pulls its connected pins low. Detection of card type is determined by detection of which of the mapped card detect lines is pulled low as illustrated in FIG. **5**, or by the (binary) state of data or other card pins mapped to a common set of controller pins as described in the aforesaid parent application. See, e.g., FIGS. **4A-E** thereof. While no separate address bus is provided, address and data are multiplexed. Control signals for latch enables, write enable and protect, output enable, and ready handshake are among the control signals.

The data lines of the miniSD and RSMMC and the Memory Stick (and MS Duo) flash-memory-card interfaces are denoted as SDD0-SDD3 and MSD0-MSD3, respectively, and occupy pins **4-7**.

Thus, it is possible to accommodate xD, standard MMC/SD, standard Memory Stick, SmartMedia, miniSD, RSMMC, and MS Duo with an 18-pin connector by multiplexing the available pins. Again, the controller chip may differentiate the pin configuration for each flash memory media type.

FIG. **6** illustrates an integrated standard connector adapter card according to one embodiment of the present invention in front view, top view, and bottom view. Adapter card **600**, shown in FIG. **6**, includes two housings, namely housing **610**



## US 7,522,424 B2

7

and housing 620. For one embodiment of the invention, the pins are in a single row. As shown from the top view of adapter card 600, a top-front set of pins 611 in housing 610 can be used to interface to an xD card, a top-rear set of pins 612 in housing 610 can be used to interface to a Smartmedia card. A top-front set of pins 621 in housing 620 can be used to interface an RSMMC card. As shown in the bottom view of adapter card 600, a bottom-front set of pins 613 in housing 610 can be used to interface to an MMC/SD card, a bottom-rear set of pins 614 in housing 610 can be used to interface to a standard size Memory Stick card. A bottom-front set of pins 622 in housing 620 can be used to interface a miniSD card. A bottom-rear set of pins 623 in housing 620 can be used to interface a Memory Stick MS Duo.

FIG. 7 illustrates an integrated standard connector adapter card, according to one embodiment of the present invention, in front view and top view. Adapter card 700, shown in FIG. 7, includes three housings, namely section 710 (Memory Stick), section 720 (SM/xD), and section 730 (MMC/SD). This arrangement allows pins to be laid out in a planar fashion, thus effecting saving in layout and allowing for assignment of one drive for each section. The spacing is designed so that only one media can be inserted at a time. For one embodiment, the Memory Stick could be on the top portion of section 710 (with MS Duo on the bottom portion), while SmartMedia is on the top portion of section 720 with xD on the bottom portion of section 720. According to one such embodiment, the MMC (including the recently designed 8-bit MMC) could be on the top-rear portion of the MMC/SD section 730, while the SD could be on the bottom-rear portion of the MMC/SD section 730. RSMMC could be on the top-front portion of the MMC/SD section 730 and miniSD could be on the bottom-front portion of the MMC/SD section 730.

The sections 710, 720, and 730 of adapter 700 are positioned vertically. Note the external pins 711, 721, and 731, are directed from each section 710, 720, and 730, respectively, such that there is no intersection of the external connections.

FIG. 7A illustrates an alternative embodiment of an adapter 700A in accordance with one embodiment of the invention. As shown in FIG. 7A, adapter 700 includes sections 710, 720, and 730 with sections 710 and 730 positioned vertically, but section 720 stacked horizontally upon section 730. In such an embodiment, external pins 711, 721 and 731 may be positioned as shown to avoid intersection or congestion of the external connections.

As described above in reference to FIG. 3, an adapter in accordance with one embodiment of the invention includes a planar element that may have a controller chip attached to a standard connector (e.g., PCMCIA, USB, WiFi, Firewire, IDE, CF, or serial ATA connector) mounted thereon. In accordance with an alternative embodiment of the invention, the controller chip is integrated into the housing of the adapter. For example, the adapter may be formed of a single piece of molded plastic, with the controller chip and an associated memory device (e.g., ROM) embedded into the molded plastic. For such an embodiment, the continuous molded plastic that forms the adapter also forms the device package for the controller die.

#### General Matters

Embodiments of the present invention provide an improved configuration for a multi-memory media adapter card. For one embodiment, the adapter may comprise an injected plastic part, forming the mechanical port, as well as holding any and all contacts in its structure, thus eliminating the multiple tolerances of conventional configurations (i.e., two PCBs sandwiching a mechanical frame). For one

8

embodiment, two half shells with integrated contacts are snapped together, allowing for a simple, but accurate mounting by means of guides for snapping them together. In particular, the total assembly of the port may be composed of two parts, a top and bottom, each with contacts and plastic, each containing part or all of the port opening, hence reducing the number of added tolerances to a maximum of one or two. By reducing the number of sub-assemblies from three or more to two or less, an easier, more precise manufacturing can be done, with only slightly higher tooling cost. However, due to the fact that it is a high-volume, commodity-type device, the higher tooling costs would be more than offset by the lower part cost, the better yield, etc. Further, by embedding the contacts in a plastic injection, such problems as metal fatigue, travel, etc., can be controlled much better, improving dramatically the life-cycle time for the port side connectors. For one embodiment of the invention, the controller and associated memory device are integrated into the adapter, rendering the adapter a complete card reader.

For one embodiment, a light pipe may be locked in place between the two half shells to conduct light from a signal lamp (e.g., LED) on the PCB to the user side of the opening, similar to networking lights sometimes integrated into networking connectors.

For one embodiment, the straddle-mount configuration is replaced with a surface mounted standard connector. This reduces the manufacturing costs and complexities associated with the straddle-mount configuration.

For one embodiment of the invention, the controller and associated memory device are integrated into the adapter rendering the adapter a complete card reader.

Embodiments of the present invention have been described in reference to flash media such as xD, standard MMC/SD, standard Memory Stick, SmartMedia, miniSD, RSMMC, and MS Duo. In general, embodiments of the invention are applicable to any generic flash media.

While the invention has been described in terms of several embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments described, but can be practiced with modification and alteration within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of limiting.

What is claimed is:

1. A media card adapter comprising:

a first planar element having an upper surface and a lower surface, the first planar element comprising molded plastic;

a second planar element having an upper surface and a lower surface, the second planar element comprising molded plastic, wherein the first planar element and the second planar element are disposed such that a port is formed between the lower surface of the first planar element and the upper surface of the second planar element, the port configured to receive a memory media card; and

a set of contact pins protruding from the lower surface of the first planar element or the upper surface of the second planar element such that the set of contact pins are disposed within the port, the set of contact pins capable of contacting a set of memory media card contacts, wherein the adapter is operable to map a subset of the set of contact pins to a set of signal lines or power lines, based on an identified type of a memory media card.

2. The media card adapter of claim 1, wherein the first planar element and the second planar element are formed from a single piece of molded plastic.

## US 7,522,424 B2

9

3. The media card adapter of claim 1, wherein the adapter is operable to receive and read a memory media card comprising at least one of xD, MMC/SD, Memory Stick, miniSD, RSMMC, and MS Duo.

4. The media card adapter of claim 1 further comprising a controller external to the adapter to map the subset of the set of contact pins to the set of signal lines or power lines, based on the identified type of the memory media card.

5. The media card adapter of claim 1 further comprising a controller within the adapter to map the subset of the set of contact pins to the set of signal lines or power lines, based on the identified type of the memory media card.

6. The media card adapter of claim 1 wherein the set of contact pins are formed from injected contacts within the molded plastic of the first planar element or the second planar element.

7. The media card adapter of claim 1 wherein the contact pins are formed such that a terminal end of a contact pin of the set of contact pins is configured to be oriented away from the set of memory media card contacts during removal of the memory media card.

8. A system comprising:

a multi-memory media adapter to read data from at least one of a plurality of memory media cards, the multi-memory media adapter comprising a first planar element having an upper surface and a lower surface, the first planar element comprising molded plastic;

the adapter comprising a second planar element having an upper surface and a lower surface, the second planar element comprising molded plastic, wherein the first planar element and the second planar element are disposed such that a port is formed between the lower surface of the first planar element and the upper surface of the second planar element, the port configured to receive a memory media card; and

the adapter further comprising a set of contact pins protruding from the lower surface of the first planar element or the upper surface of the second planar element such that the set of contact pins are disposed within the port, the set of contact pins capable of contacting a set of memory media card contacts, wherein the adapter is operable to map a subset of the set of contact pins to a set of signal lines or power lines, based on an identified type of a memory media card.

9. The system of claim 8, wherein the first planar element and the second planar element are formed from a single piece of molded plastic.

10. The system of claim 8, wherein the adapter is operable to receive and read a memory media card comprising at least one of xD, MMC/SD, Memory Stick, miniSD, RSMMC, and MS Duo.

11. The system of claim 8 further comprising a controller external to the adapter to map the subset of the set of contact pins to the set of signal lines or power lines, based on the identified type of the memory media card.

12. The system of claim 8 further comprising a controller within the adapter to map the subset of the set of contact pins to the set of signal lines or power lines, based on the identified type of the memory media card.

13. The system of claim 8 wherein the set of contact pins are formed from injected contacts within the molded plastic of the first planar element or the second planar element.

14. The system of claim 8 wherein the contact pins are formed such that a terminal end of a contact pin of the set of contact pins is configured to be oriented away from the set of memory media card contacts during removal of the memory media card.

10

15. A media card adapter comprising:

a first planar element having an upper surface and a lower surface, the first planar element comprising molded plastic;

a second planar element having an upper surface and a lower surface, the second planar element comprising molded plastic, wherein the first planar element and the second planar element are disposed such that a port is formed between the lower surface of the first planar element and the upper surface of the second planar element, the port configured to receive a memory media card;

a set of contact pins protruding from the lower surface of the first planar element or the upper surface of the second planar element such that the set of contact pins are disposed within the port, the set of contact pins capable of contacting a set of memory media card contacts; and  
a means to map a subset of the set of contact pins to a set of signal lines or power lines, based on an identified type of a memory media card.

16. The media card adapter of claim 15, wherein the first planar element and the second planar element are formed from a single piece of molded plastic.

17. The media card adapter of claim 15, wherein the adapter is operable to receive and read a memory media card comprising at least one of xD, MMC/SD, Memory Stick, miniSD, RSMMC, and MS Duo.

18. The media card adapter of claim 15, wherein the means to map the subset of the set of contact pins to the set of signal lines or power lines, comprises a controller external to the adapter.

19. The media card adapter of claim 15, wherein the means to map the subset of the set of contact pins to the set of signal lines or power lines, comprises a controller within the adapter.

20. A method comprising:

A port of a media card adapter receiving a memory media card, the port comprising of a first planar element of molded plastic and a second planar element of molded plastic, and a set of contact pins protruding from a lower surface of the first planar element and an upper surface of the second planar element, the set of contact pins capable of contacting a set of memory media card contacts of the media card;

identifying a type of the media card inserted from a plurality of memory media card types; and

mapping a subset of the set of contact pins to a set of signal lines or power lines based on the identified type of memory media card.

21. The method of claim 20, wherein the first planar element and the second planar element are formed from a single piece of molded plastic.

22. The method of claim 20, wherein the identifying the type of media card inserted further comprises identifying the media card inserted as at least one of xD, MMC/SD, Memory Stick, miniSD, RSMMC, and MS Duo.

23. The method of claim 20, wherein the mapping the subset of the set of contact pins to a set of signal lines or power lines, based on an identified type of a memory media card, is performed by a controller external to the adapter.

24. The method of claim 20, wherein the mapping the subset of the set of contact pins to a set of signal lines or power lines, based on an identified type of a memory media card, is performed by a controller internal to the adapter.

25. Apparatus comprising:

a housing having a port and a surface;

an interconnection means having a plurality of interconnection pins;

US 7,522,424 B2

11

one or more sets of contact pins mounted on said surface at locations adapted to interface with the electrical contacts of a corresponding one of a plurality of different types of memory media cards when inserted into said port;  
a set of signal lines connected to said interconnection pins;  
means for identifying the type of memory card inserted into said port;  
means for mapping power, ground or data signals between said interconnection pins and said one or more contact pins depending upon the identification of the type of memory card inserted into said port.  
26. Apparatus according to claim 25 where the means for mapping comprises a controller.  
27. Apparatus according to claim 25 wherein said means for mapping is selected from a group consisting of simple wires, flat cables, printed circuit board interconnections, or wiring traces.  
28. Apparatus comprising:  
a housing having a port and a surface;

12

a plurality of sets of contact pins mounted on said surface at locations adapted to interface with the electrical contacts of a corresponding one of a plurality of different type memory media cards when inserted into said port;  
a set of signal lines connected to an interconnection means;  
means for identifying the type of memory card inserted into said port;  
means for mapping power, ground or data signals between said interconnection means and said one or more contact pins depending upon the identification of the type of memory card inserted into said port.  
29. Apparatus according to claim 28 where said means for mapping comprises a controller.  
30. Apparatus according to claim 28 wherein said means for mapping is selected from a group consisting of simple wires, flat cables, printed circuit board interconnections, or wiring traces.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 7,522,424 B2  
APPLICATION NO. : 11/858086  
DATED : April 21, 2009  
INVENTOR(S) : Sreenath Mambakkam, Arockiyaswamy Venkidu and Larry Lawson Jones

Page 1 of 2

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page, Item (12) replace “Sreenath Mambakkan” with --Sreenath Mambakkam--

On the Title Page, Item (75) replace “Sreenath Mambakkan” with --Sreenath Mambakkam--

In FIG. 1, reference 149, replace “Compact Clash” with --Compact-Flash--

In FIG. 1, the three right arrows should touch each of the indicated boxes

In column 2, line 2, replace “151” with --151.--

In column 2, line 51, replace “straddle mount” with --straddle-mount--

In column 2, line 62, replace “211” with --211.--

In column 5, line 40, replace “compact flash” with --CompactFlash--

In column 5, line 41, replace “surface-mounted” with --surface mounted--

In column 6, line 1, replace “flashtmemory-card” with --flash-memory-card--

In column 6, line 4, replace “DIO” with --SDIO--

In column 6, line 5, replace “10 (DO)” with --10 (D0)--

In column 6, lines 7-8, replace “2L ABS” with --21. A BS--

In column 6, line 9, replace “CMD” with --MCMD--

In column 7, line 3, replace “a tap-front” with --a top-front--

In column 7, line 5, replace “Smartmedia” with --SmartMedia--

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 7,522,424 B2  
APPLICATION NO. : 11/858086  
DATED : April 21, 2009  
INVENTOR(S) : Sreenath Mambakkam, Arockiyaswamy Venkidu and Larry Lawson Jones

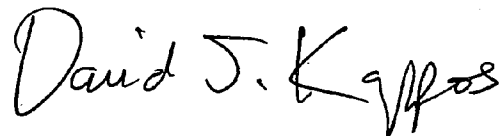
Page 2 of 2

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 7, line 43, replace “7211” with --721--

Signed and Sealed this

Eighteenth Day of August, 2009

A handwritten signature in black ink that reads "David J. Kappos". The signature is written in a cursive, flowing style.

David J. Kappos  
*Director of the United States Patent and Trademark Office*